MULTIMEDIA UNIVERSITY

STUDENT ID NO.

TABLE NO. _____

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2022/2023 (TERM ID 2210)

TIC2151 THEORY OF COMPUTATION

(All sections / Groups)

Question	Marks
1	
2	
3	
4	
Total 50 Marks (50%)	

10th FEBRUARY 2023
9.00 AM – 11.00 AM
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 7 pages only excluding the cover page.
2. Attempt All questions. The distribution of the marks for each question is given.
3. Please print all your answers clearly and neatly in the specified ANSWER BOX provided for each question. Submit this question paper at the end of the examination.

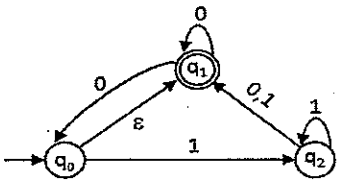
QUESTION (1)

(A) Draw state diagrams for DFAs accepting each of the following languages:

$L_1 = \{w \in \{0, 1\}^* \mid w \text{ is the set of strings that start with } 010\}$ [3 marks]

$L_2 = (00+11)(0+1)^+$ [3 marks]

(B) Convert the following NFA into an equivalent DFA. Show your steps. [5 marks]



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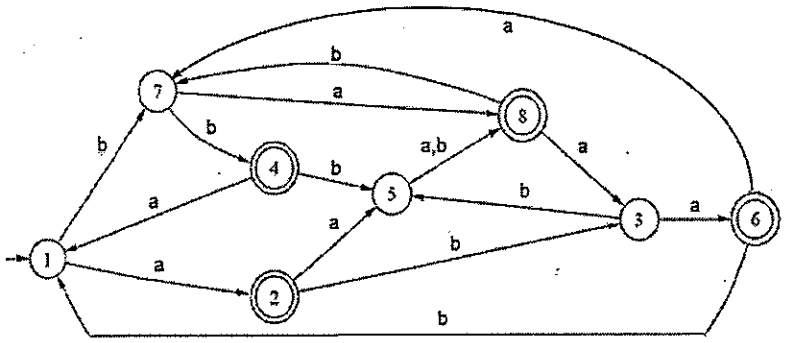
(C) Minimize the following DFA. Show your steps. [4 marks]



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QUESTION (2)

(A)

1. Determine the language corresponding to each of the following regular expressions:
   i. $0\,(0+1)^*\,0+1\,(0+1)^*\,1+0+1$ [1.5 Marks]
   ii. $(0+1)^+\,1+(0+1)^*10$ [1.5 Marks]

2. Find a regular expression corresponding to each of the following languages.
   i. $L = \{w \in \{a, b\}^* \mid w = a^{2n} b^{2m}\ , n, m \geq 1\ \}$ [1.5 Marks]
   ii. $L = \{w \in \{0, 1\}^* \mid$ String w contains one occurrence of the string 00$\}$. [1.5 Marks]

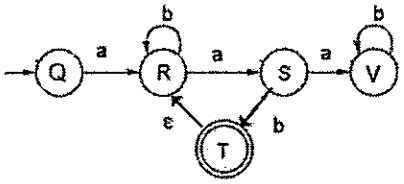
(B) Convert the following regular expression into an NFA. Follow the construction rules closely and do not just give a simpler NFA even though it is possible. [4 marks]

$$(0+1)^*\,0\,(1)^*$$

Continued...

(C)

1. What is the regular grammar corresponding to the NFA given below? [2 Marks]



2. Give the regular grammars corresponding to each of the following languages over the alphabet {a, b}.

   $L_1 = a^*b^+a$ [1.5 Mark]

   $L_2 = ab(a+b)^* + (a+b)^* bb$ [1.5 Mark]

L_1:	L_2:

Continued...

QUESTION (3)

(A) Construct a PDA over the alphabet {a, b, c} for each of the following languages:

$L = \{a^n b^{n+m} c^m \mid n,m \geq 1\}$ [4 Marks]

(B) Give the context free grammars corresponding to each of the following languages over the alphabet {a, b, c}:

$L_1 = \{aab^{2n} c^n \mid n \geq 1\}$ [1.5 Marks]

$L_2 = \{a^n b^{3m} c^n \mid m, n \geq 1\}$ [1.5 Marks]

L_1:	L_2:

(C) The following CFG grammar is in Chomsky normal form. Use the Cocke-Younger-Kasami (CYK) algorithm to determine whether the word *aabbabbb* can be derived from this grammar or not. Show your proof. [3 marks]

B => BB | XA | XY
A => BY
X => a
Y => b

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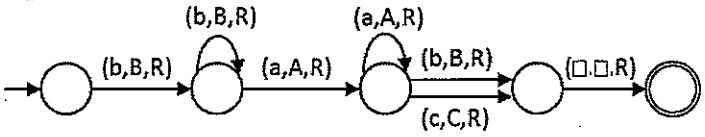
QUESTION (4)

(A) What language does the following Turing machine accept? Give the language in regular expression form. [2 marks]



(B) Construct a Turing Machine for the language $L = \{10^n1^n \mid n \geq 0\}$. [5 marks]

(C) Briefly define both *Turing-decidable* and *Turing-recognizable* languages. [3 marks]

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